

**THE  
SOLDER  
CONNECTION®**

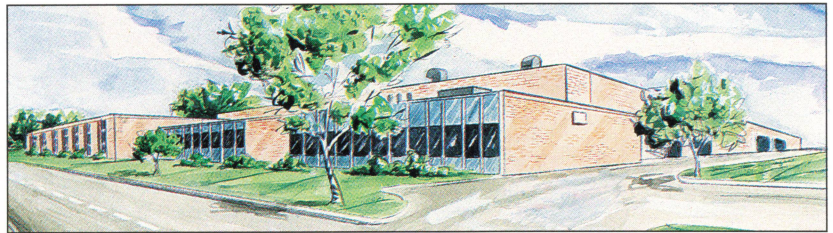




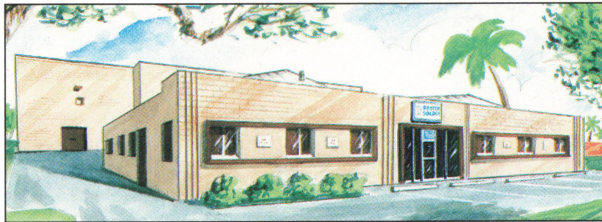
## WORLDWIDE FACILITIES

Kester Solder, was established in 1899, and is a division of Litton Systems, Inc. A leading worldwide supplier of solders and soldering chemicals, Kester has five manufacturing plants including facilities in the UNITED STATES (Chicago, IL -Newark, NJ -Anaheim, CA), CANADA (Brantford, Ontario) and SINGAPORE. Kester chemical products are also manufactured in West Germany. The processing of large volumes of tin and lead necessary as a major manufacturer of bar and wire solder requires that Kester maintain modern and efficient manufacturing

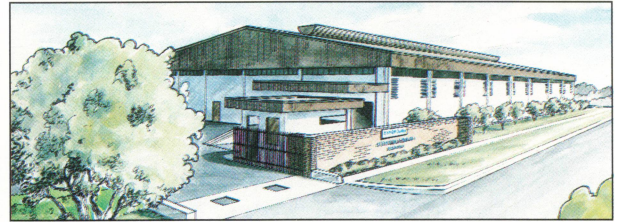
facilities and equipment. Kester also has an extensive manufacturing capability as a supplier of such products as fluxes, flux removers, metal cleaners, solderpaste and solder preforms. Quick delivery is assured and, what is most important, multiple plants protect against shipment delays caused by regional strikes or natural disasters. In addition, Kester has the most extensive distributor network to permit easy access to sources of supply for Kester products.



DES PLAINES, IL



ANAHEIM, CALIFORNIA



SINGAPORE

## Why Specify Kester?

Kester Solder is a proven leader, supplying products to an industry requiring good quality and consistency, strict alloy purity and a thorough knowledge of the processes involved in making reliable solder connections. Kester is the only manufacturer of soldering materials that has both industrial and distributor/consumer acceptance. Kester solders and fluxes meet and exceed all applicable commercial (ASTM) and military specifications.

All solder products are marked with the alloy, and the tin content is guaranteed. Kester offers a complete line of soldering materials.

Kester offers the finest flux-cored solder and external fluxes available. Having pioneered cored solder and its single core design, flux continuity is assured and flux voids are virtually eliminated. Competitive efforts to increase the number of cores or otherwise change the configuration have not improved the product.

Kester has over 80 years experience in the solder industry which is your assurance of the highest standards of business practices including:

- (A) Competitive Prices
- (B) Soldering Technology  
Kester actively contributes to advancing the technology of soldering by presenting seminars and developing soldering specifications through such organizations as IPC, AES, ASTM, IIW, IEPS, ISHM and Nepcon.
- (D) State of the Art  
Kester's role in the international marketplace assures first hand knowledge of product improvements which are incorporated into existing products.

Kester will replace at no charge any damaged materials regardless of condition because of acts of God such as floods, earthquakes, hurricanes and tornadoes. Kester will also pay the freight charges both ways in North America. Documentation by publicity and/or disaster area classification will be sufficient proof of this.

## RESEARCH & DEVELOPMENT LABORATORIES

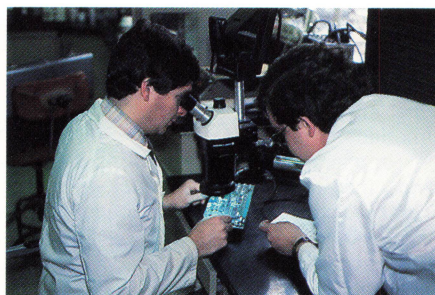
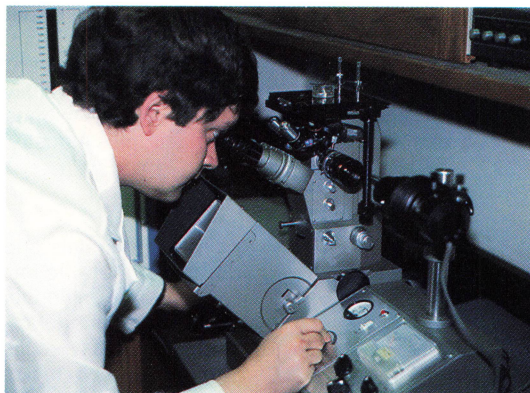
The Research & Development Laboratories of Kester Solder are dedicated to advancing the technology of soldering with innovative fluxes and other products. Kester is continually assessing the needs of the market place to determine areas where research should be performed to develop products to serve specific requirements. The Kester Solder laboratories are equipped with an extensive array of research equipment which is used to study various parameters which affect the soldering process. This laboratory testing and feedback from our customers facilitates improvements of existing products as well as the development of new products.



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Technical assistance is as close as the telephone. All regional sales offices can provide technical information related to products and soldering processes. The ready access to this type of service is a key element in Kester's leading position in the international market place. Full functioning technical service laboratories are located in Chicago, Singapore and West Germany to provide further technical support. The technical service laboratories have available various test equipment to determine the causes and solutions for customers' soldering problems. Whether it's a question of the appropriate flux for a given application or the evaluation of a circuit board solderability or cleaning problem, Kester can find the answer.



Commonly specified solder alloys are shown in the table. The selection of alloy is determined by application, melting temperature and physical properties. The alloys listed may be available in forms other than those indicated. Other solder alloys are also available.

SOLDER ALLOYS AND AVAILABLE FORMS						
ALLOY	MELTING	RANGE	AVAILABLE FORMS			
	°F	°C	WIRE	BAR	SOLDERPASTE	PREFORMS
<b>TIN-LEAD</b>						
63Sn/37Pb	361	183	X	X	X	X
60Sn/40Pb	361-374	183-190	X	X	X	X
No. 150	368-394	187-201		X		
55Sn/45Pb	361-397	183-203	X	X		
50Sn/50Pb	361-420	183-214	X	X	X	X
45Sn/55Pb	361-440	183-225	X	X	X	
40Sn/60Pb	361-460	183-238	X	X	X	X
35Sn/65Pb	361-477	183-247	X	X		X
30Sn/70Pb	361-496	183-258	X	X	X	X
No. 123	366-503	186-262		X		
25Sn/75Pb	361-514	183-268	X	X	X	
20Sn/80Pb	361-536	183-280	X	X		X
10Sn/90Pb	514-576	268-302	X	X		X
5Sn/95Pb	574-597	301-314				X
<b>SILVER-BEARING</b>						
62Sn/36Pb/2Ag	354-372	179-189	X	X	X	X
96.5Sn/3.5Ag	430	221	X	X	X	X
96Sn/4Ag	430-444	221-229	X	X	X	X
95Sn/5Ag	430-473	221-245	X	X	X	X
60Sn/36Pb/4Ag	354-475	179-246	X	X	X	
10Sn/88Pb/2Ag	514-570	268-299	X	X	X	X
5Sn/93.5Pb/1.5Ag	565-574	296-301			X	
<b>OTHER ALLOYS</b>						
15.5Sn/32Pb/52.5Bi	203	95			X	X
42Sn/58Bi	281	139			X	
43Sn/43Pb/14Bi	291-325	144-163	X	X	X	X
100%Sn	450	232	X	X	X	X
95Sn/5Sb	450-464	232-240	X	X	X	X



# ULTRAPURE® PLATING ANODES

Good solderability of electroplated tin and tin-lead printed circuit boards and component leads requires a tightly controlled plating process and plating anodes of the highest purity and uniformity. Kester Ultrapure® plating anodes are the highest quality anodes available to the electronics industry.

## HIGH PURITY

Use of virgin metals and control of metallic impurities to a minimum level in the manufacturing process results in the optimum performance of Ultrapure® anodes. Excessive metallic impurities in plating anodes can cause sludge formation on anodes, necking of anodes, darkening of the deposited electroplate and inferior reflow characteristics of the deposit. Strict control of the tin content of Ultrapure® anodes provides added reliability.

Kester's quality control standard for maximum allowable metallic impurities in Ultrapure® anodes assures extremely high purity. A typical analysis for Ultrapure® tin-lead anodes illustrates an absolute minimum of metallic impurities.

Special processing eliminates oxides, trapped gases, sulfur and other non-metallic inclusions. Ultrapure® anodes usually do not require bagging because there is a minimum of sludge formation and flaking.

## HIGH ANODE EFFICIENCY

Casting is normally the most economical method for fabricating tin and tin-lead plating anodes. The major disadvantage is that excessive grain growth due to slow cooling and alloy segregation may result. The preferred method for anode manufacture is extrusion.

Ultrapure® plating anodes are extruded under high pressure which assures a dense, fine grain structure with continuous uniformity. Uniform dissolution of the anode in the plating bath results, with necking reduced to a minimum. The fine grain size permits the use of higher current densities without passivating the anodes.

The high purity and uniformity of Kester Ultrapure® anodes provides improved anode efficiency. This means a longer anode life, fewer chemical additions to the plating bath, better solderability of plated parts and an overall economy in use.

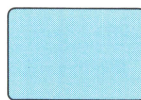
## STANDARD SHAPES AND DIMENSIONS

All dimensions shown are measured in inches. Other dimensions and shapes may be available for special applications.

The elliptical shape provides optimum anode efficiency for many applications. Star-shaped design increases the surface area 2.5 times compared to a round anode. Star-shaped anodes are ideal for barrel plating where cathode surface area is high and there is insufficient room to place additional anodes. Corrugated anodes are designed for lead anodes used in chrome plating applications. Ultrapure® anodes are normally supplied drilled and tapped 3/8-16 for insertion of hooks. Ultrapure® anodes are supplied with or without monel hooks. Monel hooks provide better conductivity and improved corrosion resistance. When anodes are heavier than 30 pounds, Ultrapure® anodes are supplied with the monel hook soldered into the anode.

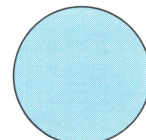
### Rectangular

1 x 1-1/2    1-1/2 x 4  
1 x 3        1-1/2 x 3  
1 x 4        2 x 4  
1/2 x 3      1-15/16 x 3-7/8



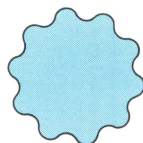
### Round

Diameter 1-1/2  
1-3/4  
2



### Corrugated Round Ripple

Diameter 1-1/2  
2



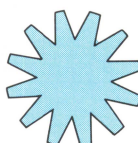
### Elliptical

1-1/2 x 3  
1 x 3



### Star-Shaped O.D.

3



## KESTER ULTRAPURE® ANODES

Element	Maximum Allowable Impurities	Ultrapure® Tin Anodes Typical Analysis
Pb	0.050 *	0.040
Sb	0.030 *	0.020
Cu	0.015	0.003
Au	0.002	0.001
Al	0.002	—
Cd	0.0003	—
Zn	0.0003	—
Ag	0.002	0.001
Bi	0.030	0.015
In	0.005	—
As	0.020	<0.020
Fe	0.010	0.007
Ni	0.002	—

Shown in weight percent

\*when not specified as an alloy component

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## BAR AND INGOT SOLDER

### EXTRUDED E-BAR™ SOLDER

Most soldering applications require a high purity, uniformly alloyed bar solder for optimum performance and process consistency. Kester E-Bar™ solder is made from Grade A virgin metals and manufactured under a controlled process to produce a high purity solder. Quality requirements for E-Bar™ solder are much stricter than military and ASTM specifications to meet the needs of today's automated electronics soldering operations. Impurities such as copper, cadmium, zinc, aluminum and iron are at a minimum. The extrusion process assures a uniform alloy composition that results in more consistent and reliable soldered connections. The manufacturing process for E-Bar™ solder also minimizes metallic oxides and virtually eliminates sulfur, non-metallic inclusions and other possible contaminants.

The quality of Kester E-Bar™ solder is comparable to or better than the highest grades of bar solder available from other suppliers to the electronics industry. E-Bar™ solder is made in 1 lb extruded bars and is available in a wide range of alloys.

### ULTRAPURE™ BAR SOLDER

Ultrapure™ bar solder is the highest quality bar solder available. Ultrapure™ solder is essentially plating anode quality available in a bar solder. Strict controls are maintained throughout every step of the proprietary manufacturing process. Tin and lead are selected from the best available. Tighter limitations on metallic impurities than are placed on high purity

E-Bar™ solder are employed. Every step of the Ultrapure™ process has the goal to eliminate oxidation. Ultrapure™ bar solder has the lowest possible level of metallic oxides. The result is less dross upon initial melting, elimination of non-metallic inclusions, brighter connections and more connections per pound of solder.

Ultrapure™ bar solder is made in 1-2/3 lb bars (1/2 kg, 3/4 kg and 5 kg in Singapore) and is available in a wide range of alloys.

### EXTRUDED FLO-BAR™

Flo-Bar™ is a 10 lb extruded bar manufactured to meet E-Bar™ grade quality. Flo-Bar™ is suited for situations where the larger size is more convenient for handling or certain automatic solder feeding systems. Flo-Bar™ is also available in Ultrapure™ grade upon request.

### E-Z DRAW BULK PAK™

This cost saving packaging permits easier storage and handling of large volumes of solid or flux-cored wire solder. It is ideal for use with automated soldering equipment. E-Z Draw Bulk Paks™ are available in two container sizes: 50-60 lbs and 200-350 lbs. The exact weight per container will depend on wire diameter and the density of a given solder alloy.



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# FLUX-CORE SOLDER

## KESTER "44"® ROSIN CORE SOLDER

The excellent wetting action of "44"® rosin is a most outstanding property, and even more important and more significant is the fact that the flux is completely non-corrosive and electrically non-conductive. Throughout its long years of wide usage in the electric and electronic industries, involving billions of soldered connections, there has never been a known case of corrosion by the flux residue.

Kester "44"® rosin core is on the Qualified Products List under Specification QQ-S-571, Type WRAP.

## KESTER "282" ROSIN CORE SOLDER

Kester "282" rosin flux is a mildly activated rosin flux that conforms to Type RMA of Federal Specification QQ-S-571. A small amount of a very effective activating agent is incorporated into this water white gum rosin flux. The dry flux residue after soldering has very good electrical insulating properties. The noncorrosive, nonconductive, fungus-resistant properties of the residue are requirements for critical electronic assemblies. More active than the plastic rosin core, Kester "282" rosin core flux is more effective on difficult-to-solder assemblies where a fully activated flux core solder is not permissible.

## KESTER "285" ROSIN CORE SOLDER

Kester "285" rosin flux conforms to Type RMA of Federal Specification QQ-S-571 and is on the Qualified Products List. It has been developed for applications where difficult assemblies are to be soldered, but the process specification stipulates use of Type RMA flux. The fluxing ability of Kester "285" is much greater than ordinary RMA fluxes and is nearly comparable to Type RA fluxes. The high mobility and fast spreading action of Kester "285" results in fast production line soldering without sacrificing reliability of the assembly.

## KESTER PLASTIC ROSIN CORE SOLDER

For over sixty years, Kester plastic rosin core solder has dominated the field of pure rosin core solders. Kester pure plastic rosin is made from purest grade WW gum rosin without additives, is completely noncorrosive, electrically nonconductive and fungus-resistant and is on the Qualified Products List under the Federal Specification QQ-S-571, Type WRP, for applications requiring non-activated flux.

## KESTER "232" ROSIN CORE SOLDER

A mildly activated rosin flux conforming to the German specification DIN 8511, Type 32. While the flux is more effective than plain rosin flux, the composition does not contain any halogen. Designed for applications where the flux is not to be removed since the residue is very inactive.

## KESTER "331" ORGANIC FLUX CORE SOLDER



This cored solder version of the No. 2331 neutral organic water soluble liquid flux is more effective than rosin fluxes in soldering difficult metals. The flux is more heat stable than other organic fluxes resulting in minimal smoke and odor. The residue can be completely removed with a simple water rinse.

## KESTER "88"™ HIGHLY ACTIVATED ROSIN CORE SOLDER

Kester "88"™ provides the highest activity of any available rosin flux for cored solder wire. Kester "88"™ is recommended for difficult-to-solder metals such as nickel or for metals with excessive oxides to improve productivity.

## KESTER STANDARD FLUX-CORE SIZES

(Other core sizes available for critical applications)

NO. 66 REGULAR	NO. 58 MEDIUM
FLUX 	FLUX 
SOLDER	SOLDER
*3.3%	*2.2%

\*Average weight percentage for 60/40 tin/lead alloy. Other alloys will vary slightly since the core size is a constant volume ratio.

## COMMON ALLOYS, SOLID WIRE, STANDARD WIRE DIAMETERS

Kester flux-core and solid wire solders are manufactured in many alloys including those conforming to Federal Specification QQ-S-571 and ASTM B32. Wire solders of any diameter from .250 to .010 inch (6.00 to .25mm) are available. The following are the most commonly specified diameters.

### COMMONLY SPECIFIED DIAMETERS

Inch	English Wire Gauge Equiv.	MM Equiv.
.125	11	3.00
.093	13	2.50
.062	16	1.50
.050	18	1.20
.040	19	1.00
.031	21	.75
.025	23	.60
.020	25	.50
.015	—	.40
.010	31	.25

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# SOLDER PASTE & SOLDER PREFORMS

## RHEOMET® SOLDER PASTE FOR ELECTRONICS

Kester specializes in solder paste products tailored to current process techniques. Formulations have been developed specifically to meet the requirements of surface mount on both standard glass-epoxy and hybrid circuitry. Rheological properties are fashioned to work smoothly with common dispensing methods while still meeting the restrictions of printed circuit pattern densities. Kester solder paste systems can be used with a broad range of reflow techniques including infra-red, hot belt or vapor phase.

Extended shelf life and usability help make Kester Rheomet® products the choice for new, developing or mature surface mount operations.

## SOLDER POWDER

Kester realizes the importance of using high quality solder powder for the manufacture of electronic grade solder paste, and only uses the best available. Top quality solder powder is spherical, consistently sized, low in oxide content and made from pure virgin metals. Without electronic grade solder powder, it is virtually impossible to make solder paste which both creates defect free solder joints and contains flux mild enough to guarantee future reliability.

## FLUX VEHICLE

High quality solder powder is suspended in "state-of-the-art" flux formulations which place special emphasis on eliminating solder balls and other common defects while maintaining a minimum effect on electronic reliability. Kester Rheomet® solder pastes are formulated with flux types tailored to common application methods and specifications. Activity levels range from very mild "R" rosin fluxes to more aggressive "OA" organic water soluble types.

Documented in-line process control and product inspection procedures guarantee batch-to-batch uniformity.

## FLO-RITE® SOLDER PASTE FOR INDUSTRIAL APPLICATIONS

Kester Flo-Rite® solder pastes are designed for high volume industrial use where cost effectiveness demands an inexpensive product. Large batch sizes, less stringently controlled solder powder and production level quality control make this possible. Although Flo-Rite® solder pastes have not been developed to meet the requirements of sensitive electronic assembly, formulations are available in most flux activity levels and are compatible with standard industrial heating and application methods. Because of the price competitive nature of Flo-Rite® materials, only jar and bulk packaging are available.

## ADDITIONAL INFORMATION

Additional information on Kester solder paste can be requested from the Kester Engineered Products Group in Chicago or from any Kester Regional Sales Office. Available information includes:-comprehensive data sheets, material safety data sheets, application information, outlines for setting-up quality control and Kester's aggressive quality assurance program.

## KESTER SOLDERFORMS®

Kester Solderforms® are stamped, extruded, compacted or formed pieces of pure soft solder alloys manufactured with strict known tolerances to customer specifications.

Solderforms® are consistent, delivering a precise amount of solder to the right area at the right time. Using properly designed Solderforms® allows inaccessible or defect sensitive joints to be completed easily. Defects such as bridging and solder shorts which are common when making close proximity joints with other assembly methods can be eliminated by using Solderforms®. New levels of automation are available to solder preform users often eliminating the need for some manual assembly, inspection and touch-up.

Kester Solderforms® can be produced with a specified quantity of flux either internally as a sandwich or as an external coating, eliminating the need for liquid flux addition and guaranteeing that a consistent amount of flux and solder is delivered to the correct area.

By improving assembly techniques, inspection and rework can be significantly reduced. Making solder joints correctly the first time helps cut down on assembly related field failures.

## ADDITIONAL INFORMATION

A twelve page Design and Specification Handbook which lists standard Kester Solderforms® shapes, sizes and tolerances is available from any Kester sales office. Included within this booklet are basic guidelines for selection of the correct alloy, flux and configuration for many soldering applications. Information is given on basic soldering principles along with helpful hints on the proper use of Solderforms®.

Separate data sheets and safety information are also available for both the internal and external fluxes used with Kester Solderforms®.



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# SOLDERING FLUXES

## ROSIN FLUXES CONFORMING TO MIL-F-14256

For soldering of critical electronic and electrical assemblies, the Department of Defense has established rigid requirements for noncorrosive rosin fluxes. Rosin, because of its insulating properties at room temperature, is well recognized as the most desirable flux for soldering applications where flux residue must be as nearly neutral as possible.

Kester rosin fluxes are formulated with high quality purified Grade WW rosin conforming to LLL-R-626 in specially blended solvent systems. The choice of the proper flux formula is based on the soldering application, desired rosin percentage, type of solvent and the activity level required.

### NON-ACTIVATED ROSIN (TYPE R) FORMULA NO. 135

This flux is 40% by weight rosin dissolved in an alcohol solvent. The excellent mobility of this flux caused by the low surface tension of the solvent system makes No. 135 rosin flux the choice for the most critical soldering applications.

### FORMULA NO. 145

This flux is a modification of No. 135 diluted to 25% rosin solids. Many solderability test procedures specify this 25% rosin in alcohol flux.

### FORMULA NO. 115

This flux is a concentrated formula of 50% rosin dissolved in a high-boiling terpene solvent. Applications include oven soldering and high temperature tinning of leads where the heat stability and higher flash point are desirable.

### FORMULA NO. 121

This flux is a modification of No. 115 diluted to 38% rosin solids.

## MILDLY ACTIVATED ROSIN (TYPE RMA)

### FORMULA NO. 197

Kester flux Formula No. 197 has been developed for use in the electronics industry where a more active flux than plain rosin is required but where highly activated fluxes are considered potentially conductive. Use of a minimum of ionic activating agent results in a residue that is practically inert after soldering.

Kester Flux No. 197 is formulated for foam fluxing applications as well as for dipping, brushing or spraying methods. The surface tension has been adjusted so that a low air pressure will produce a very uniform head of small bubbles.

### FORMULA NO. 185

This flux has been developed for applications where difficult assemblies are to be soldered, but the process specification stipulates use of Type RMA flux. Although nearly as active as Type RA flux, the residue properties of #185 flux are comparable to typical RMA fluxes. Formula No. 185 is the best RMA flux available in the electronics industry today.

## ACTIVATED-HALOGEN FREE ROSIN (TYPE DIN-32)

### FORMULA NO. 932

This flux is more active than plain rosin but does not contain halogen activators in conformance with German specification DIN8511, Type 32. Formula No. 932 contains only 13% solids and leaves minimal residue which is usually left on the soldered assembly. MIL-F-14256 is not applicable to No. 932.

## FULLY ACTIVATED ROSIN (TYPE RA)

Though nearly as active as conventional industrial strength rosin fluxes, these military approved modifications of popular Kester fluxes meet all the requirements of MIL-F-14256, Type RA. The cleaning or oxide removal ability is much improved over the RMA type rosin fluxes.

Formulated for high-speed, automated soldering applications, these Type RA rosin fluxes can be applied by foaming, brushing, waving or spraying. The flux residue is dry, non-sticky and non-corrosive. These Type RA Fluxes are liquid equivalents of Kester "44" resin used in cored wire solder conforming to QQ-S-571e.

The selection of flux is determined by the soldering application, amount of residue and degree of solderability of parts to be soldered.

### FORMULA NO. 1544-MIL

For dip tinning of leads or wave fluxing applications.

### FORMULA NO. 1585-MIL

For foam, wave or spray fluxing applications. This is the standard Type RA flux for the majority of soldering applications.

### FORMULA NO. 1587-MIL

For foam fluxing with minimum residue.

### FORMULA NO. 1636-MIL

For foam fluxing applications where a slow-evaporating, high flash point solvent is preferred.



### SPECIFIC GRAVITY

Flux	@ 75° F	Thinner
115	0.957	101
121	0.933	101
135	0.880	108
145	0.866	108
185	0.878	109
197	0.896	108
932	0.848	108
1544-MIL	0.928	104
1585-MIL	0.890	103
1587-MIL	0.863	103
1636-MIL	0.931	102

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## FULLY ACTIVATED ROSIN FLUXES

These fluxes are clear, homogeneous solutions of Grade WW rosin in special alcohol solvent systems into which have been incorporated highly efficient activating agents. The flux residues are non-corrosive and non-conductive when subjected to normal conditions where the solvent is volatilized and the residue is dry. The residues of these fluxes have been determined to be non-corrosive when subjected to environmental conditions of 100°F and 95% relative humidity for a period of 72 hours.

### FORMULA NO. 1544

This flux may be regarded as the most active of the non-corrosive rosin type fluxes. It is characterized by an excellent wetting action that distinguishes it from other rosin fluxes. The high mobility and fast-spreading action of this flux permits soldering even on such metals as brass and nickel, which are extremely difficult to solder with ordinary rosin.

In spite of this "instant-action behavior", the flux residue is strictly non-corrosive and electrically non-conductive, and the flux is used widely throughout the entire electrical and electronic industries.

### FORMULA NO. 1571

A more dilute formulation than Kester No. 1544, this flux is better adapted to the diverse and multiple requirements of general hand or dip soldering of printed circuit assemblies. The reduced solids content not only facilitates ease of application, but provides a controlled amount of flux residue.

### FORMULA NO. 1545

Further reduction of the solids content requires cleaner circuit assemblies but will result in less flux residue.

### FORMULA NO. 1547

This flux leaves a minimal amount of residue after soldering, but requires clean parts to complete reliable soldered connections.

## FLUX THINNER

Selecting the correct thinner for reducing solids or replacing evaporated solvent will result in maximum efficiency of the flux.

## FOAMING ACTIVATED ROSIN FLUXES

Kester foaming activated rosin fluxes have been developed for foam fluxing applications in automatic wave solder machines. The surface tension and vapor pressure have been adjusted so that a low air

pressure will produce a high, uniform head of bubbles. The controlled solvent evaporation assures a more constant flux composition for increased reliability.

### FORMULA NO. 1585

This flux is essentially the same as Formula No. 1571 with an adjustment made in the surface tension to create a fine head of bubbles for foam fluxing applications. The heavier solids content virtually eliminates icicling, bridging and webbing of the solder.

### FORMULA NO. 1587

The reduced solids content of this formula minimizes the amount of residue after soldering while still maintaining excellent foaming and fluxing properties. Circuit boards and component leads must be in a solderable condition for this flux to function with high speed production methods.

### FORMULA NOS. 1588 AND 1589

These dilute formulations are for applications where an absolute minimum of flux residue is desirable. The increased activity and low solids content result in more reliable high speed automated soldering.

### FORMULA NO. 1515

A low halide rosin flux for applications that require a low solids content flux (15%) that has good activity but does not reduce reliability of the assembly when residues are not removed after soldering. This product performs well against many fluxes containing 1.5 to 3 times the amount of ionic halide activator. The performance properties of No. 1515 make it suitable for wave soldering of surface mount components onto circuit board assemblies.

### FORMULA NO. 195

Another low solids, low halide rosin flux suitable for most of the same applications as Formula No. 1515. A major advantage of this flux is the lusterless "frosty" appearance that the residue imparts on solder joints allowing easier visual inspection of wave soldered boards. The elimination of glare under high intensity inspection lamps results in an increase in post-soldering inspection productivity.

### FORMULA NOS. 1636, 1626, 1616

These fluxes employ a relatively nonvolatile solvent vehicle, eliminating the labor required for checking density, making calculations and adding thinner. This minimum solvent evaporation loss assures a constant flux composition for increased reliability.



## Residue Removal

The rosin flux residues can be completely removed with any Kester vapor degreasing solvent or cold flux remover.

PROPERTIES OF FLUX AND THINNER FORMULAS													
	195	1544	1571	1545	1547	1585	1587	1588	1589	1636	1626	1616	1515
Specific gravity @ 75°F.....	0.837	0.928	0.893	0.878	0.854	0.890	0.863	0.850	0.837	0.931	0.910	0.902	0.836
Solids % .....	15	50	36	30	20	36	25	20	16	35	25	15	15
Flashpoint °F. (T.O.C.) .....	65	65	65	65	65	65	65	65	65	145	145	145	65
Thinner .....	3030	104	104	104	104	103	103	108	108	102	102	102	3030



# SOLDERING FLUXES



## ORGANIC FLUXES

Organic fluxes are the commonly called "water soluble fluxes." Organic fluxes generally provide greater fluxing ability than rosin, but the ionizable nature of the water soluble residue makes organic fluxes too conductive and potentially corrosive to leave on electronic assemblies. The organic fluxes are not as heat stable as rosin fluxes but do provide more rapid fluxing action for high speed soldering.

Because of the ability to remove organic flux residue with water and the ease of disposal of the cleaning solutions, organic fluxes are more frequently being used for electronics soldering applications. A circuit board assembly must be designed for the use of organic fluxes and water cleaning since all of the residue must be removed.

### FORMULA NO. 2330

A fast acting, very active organic flux for use in automated wave soldering applications. The rapid cleaning ability on copper, solderplate and tin-nickel make this flux the choice for difficult to solder circuit boards.

### FORMULA NO. 2300

A unique formulation incorporating a high solids content combined with a small amount of very effective activating agents. Other organic, water soluble fluxes contain two or three times the halide content. Using less halide results in easier removal of flux residue. The high solids content permits thinning of this flux up to 1:1 with thinner without affecting the soldering properties.

SEMICONDUCTOR LEAD TINNING PRODUCT SELECTOR GUIDE		
FLUX TYPE		
ORGANIC	HALIDE ACTIVATED	1429 1429-F 2300 2330
	HALIDE FREE	2163 2161
INORGANIC ACID	NOT RECOMMENDED	

### PROPERTIES OF FLUXES AND THINNERS

	2161	2163	2330	2331	2300	2211	1429	1429F	4660	4662	4600	4422	4161	4163
Specific gravity @ 75° F. ....	0.890	0.954	0.950	0.893	1.05	0.906	1.07	0.990	0.814	0.785	0.802	0.820	0.801	0.792
Solids % .....	16	36	13.4	14	35	21	17	11	—	—	—	—	—	—
Flash Point ° F (T.O.C.) .....	71	65	60	60	60	60	none	69	60	60	60	60	71	60
Thinner .....	4161	4163	4660	4662	4600	4422	—	4422	—	—	—	—	—	—

## REMOVING ORGANIC FLUX RESIDUE

Water will effectively remove residue of organic acid fluxes only if the soldered assembly is cleaned immediately after soldering, preferably before it cools down. If the flux residue has time to react with the solder surface, very difficult-to-remove reaction products such as lead chloride will not come off in plain water. Kester No. 5760 neutralizer, when mixed to make a 2-10% solution with water, effectively solubilizes chloride complex residues for final water rinse. Formula No. 5761 is a low foaming modification which is used in spray cleaning applications.

### FORMULA NO. 2161

Designed for automated semiconductor component lead tinning applications, No. 2161 will perform effectively on leads made of copper, nickel plate and nickel-iron (Alloy 42). This flux contains no chlorides or bromides which may be detrimental to component reliability. Residues are readily removed with plain water. Both plastic and ceramic packages can

### FORMULA NO. 2211

A completely organic soldering flux with a rapidly evaporating alcohol solvent system. Designed for foam fluxing applications, this flux has an activity range of 100°-600°F and solders without spattering.

### FORMULA NO. 1429

This flux is the formula originally developed by the Battelle Institute. During the heat of soldering the flux self-neutralizes, provided all of the flux is properly heated.

From a practical viewpoint, the flux generally is not always completely neutralized and removal of the residue is usually required. Though intended for general soldering use, No. 1429, like any organic flux, will not withstand prolonged soldering temperatures without decomposing.

### FORMULA NO. 1429-F

An alcohol-modified version of No. 1429, adjusted to control the foaming properties in automated equipment. Spattering during hand soldering is less than when using No. 1429.

### FORMULA NO. 2331

No. 2331 is the standard organic flux for a variety of automated circuit board soldering applications. This latest development in organic fluxes is not a self neutralizing flux but rather a truly neutral formulation. It cannot attack metal or epoxy-glass surfaces as experienced with the acid type organic fluxes. The residue can be removed completely with plain water without neutralizers. This biodegradable, non-acid flux is designed for modern wave or drag soldering machines. The formula contains no water, polyglycols or non-water-soluble solvent, is non-spattering and environmentally safe.

be solder coated using No. 2161. The flux will not attack the glass seal of ceramic packages.

### FORMULA NO. 2163

This halide-free organic flux has been developed for semiconductor component lead tinning applications and will perform effectively on leads made of copper, nickel plate and nickel-iron (Alloy 42). This formula has improved surface tension properties to eliminate icicling, excessive solder and bridging defects.

### FORMULA NO. 2436 LEVEL-BRITE™ HOT AIR LEVELING FLUX

This thermally stable organic flux is used in hot air leveling equipment to produce solder coated boards of high reliability. No. 2436 provides excellent wetting on copper circuits while maintaining a low chloride content. The flux residue is completely removed in plain water. Boards exhibit high ionic cleanliness and no degradation of surface insulation resistance. No. 2436 does not create excessive foaming in water cleaning systems.



**KESTER®**  
SOLDER



## SOLDERING FLUXES

### INORGANIC ACID FLUXES

Kester inorganic acid fluxes are solutions of inorganic salts for use as general all-purpose fluxes. These fluxes are active formulations for soldering difficult-to-solder metals.

Inorganic acid fluxes were developed for non-electronic soldering applications, and provide maximum wetting, leaving residues which can be removed with water. Those fluxes are not recommended for electrical or electronic applications, and flux residues should be carefully removed to prevent corrosion caused by residual chloride salts. All formulations can be used for soldering with an iron, torch, oven, induction coils or resistance tools.

#### SELECTION OF TYPE

There are seven types of Kester inorganic acid fluxes with a selection based on type of metal being soldered, flux activity, type of salt and type of solvent system.

#### FORMULA NO. 415

The mildest of the acid type fluxes, No. 415 is generally used for applications where rapid soldering can be accomplished at controlled temperatures. The flux boils away at 700°F., leaving little or no residue after soldering. The special solvent system reduces spattering during soldering.

#### FORMULA NO. 541

With solids content about half that of No. 415 flux, this solution is considerably more acidified. While having the ability to solder badly oxidized metals, No. 541 flux will leave a minimum of corrosive residue after soldering.

#### FORMULA NO. 751

Developed especially for soldering to brass, the

formulation is free from ammonium salts which could cause intergranular corrosion or "cracking" of the brass.

#### FORMULA NO. 715

This flux is the standard all-purpose flux for general soldering, with high activity, stability and heat resistance. Rapid soldering can be accomplished on most metals with this concentrated flux.

#### FORMULA NO. 737

This flux is less concentrated than No. 715 flux for applications not requiring the higher activity. The reduction of active salts results in less residue and easier cleaning of parts after soldering. The additional solvent also causes the flux to be more mobile, enabling the solder to spread better than with No. 715 flux.

#### FORMULA NO. 815

This is the most active flux Kester offers! Formula No. 815 flux can be used for soldering all common metals except aluminum and manganese, but it should be used only after other types have failed to remove oxidation sufficiently to allow solder flow. This flux also would be the most corrosive.

#### FORMULA NO. 817

Though milder than No. 815, this flux is a very active solution developed for soldering nickel-chrome and stainless steel alloys where regular acid fluxes such as No. 715 are not active enough to remove the resistant oxide coatings.



### KESTER SOLDERING PASTE FLUXES

For applications where a liquid flux may be hazardous or inconvenient to use, these flux formulations are available in paste form.

#### FORMULA NO. SP30—ZINC CHLORIDE TYPE

Equivalent to No. 715 flux this formula is for difficult-to-solder metals. The corrosive nature of the residue precludes its use for electrical applications.

#### FORMULA NO. SP44—ACTIVATED ROSIN TYPE

A paste version of No. 1544 flux, this formula makes an ideal bench top flux for touch-up and soldering of electronic assemblies without any corrosive residue.

#### FORMULA NO. SP32—CHLORIDE-FREE ROSIN TYPE

More active than plain rosin fluxes, this formula contains no halide salt activators. For critical applications where an activated rosin flux is not permitted.

#### FORMULA NO. SP-274

A mildly activated rosin paste flux for use in high reliability microelectronics applications to reflow solder coated surfaces together. Ideal for some surface mount component soldering applications. The paste flux can be applied by screen printing, stenciling or syringe dispensing.

#### FORMULA NO. SP-174

A nonactivated rosin paste flux designed for applications similar to that for Formula No. SP-274. The paste flux can be applied by screen printing, stenciling or syringe dispensing.



## SOLDERING PASTE FLUXES

**THE SOLDER CONNECTION®**



## VAPOR DEGREASING SOLVENTS



Kester vapor degreasing solvents are blends of high purity fluorocarbons and electronic grade solvents capable of completely removing rosin, oils and activators which remain after soldering with activated rosin flux. Kester solvent formulations are more economical than fluorinated solvents, have low boiling temperatures and good heat-stability.

All formulations can be reclaimed by distillation, are stabilized against chemical degradation and can be used by cold immersion or spraying, in vapor degreasers or in ultrasonic equipment. The formulas vary by strength and boiling point and components should be tested for compatibility before using the solvent.

### FORMULA NO. 5130

The most effective solvent, boiling at 105°F., will remove even the hardest, baked-on, polymerized rosin. The low boiling point reduces heat damage to components. Plastics and markings should be tested prior to immersion in No. 5130 due to the very strong solvent action of this cleaner.

### FORMULA NO. 5120

This widely used medium strength solvent has a

practical boiling temperature in vapor cleaning equipment at 142°F. Formula No. 5120 provides stronger cleaning power and better economy in use compared to mild fluorinated solvents. Rosin and activating agent residues are rapidly removed from soldered assemblies with minimal effect on markings or components.

### FORMULA NO. 5121

A modified version of No. 5120 made for in-line conveyorized vapor degreasing equipment or large vapor degreasers employing storage tanks or external stills. This is the standard solvent for most applications. No. 5121 has a very narrow boiling range, is medium strength and inhibited against acid degradation. No. 5121 is the optimum solvent from a cost/performance standpoint.

### FORMULA NO. 5110

A very mild fluorocarbon-alcohol blend, boiling at 100°F., No. 5110 will effectively remove soft rosin residues and activating agents with no attack on critical components, such as polystyrene, polycarbonate and other plastics.

## ROSIN RESIDUE REMOVERS & ELECTRONIC CLEANERS



Kester rosin residue removers have been formulated to completely remove rosin or resin flux residues, oils and grease in applications where vapor degreasing is not available and more economical solvents are desired. Sufficient solvent should be used to remove the dissolved residue from the parts being cleaned. With the exception of Formula No. 5211, all Kester rosin residue removers can be distilled for re-use.

### FORMULA NO. AP-20

This solvent is characterized by its unusually fast and effective solvent action on rosin residues. Boiling at 245°F., Formula No. AP-20 can be reclaimed by distillation and is designed for general use in cleaning equipment or on soldering benches.

### FORMULA NO. 5240

Formula No. 5240 is slightly milder and has less odor than Formula No. AP-20. Boiling at 249°F, this solvent is suitable for use in automatic soldering machines incorporating in-line cleaning equipment as well as for manual cleaning. The low evaporation rate, rapid solvent action and ease of reclamation by distillation make this solvent very economical to use.

### FORMULA NO. 5235

A medium strength solvent developed for applications where a more rapidly evaporating solvent than No. 5240 or No. AP-20 is preferred. This economical solvent blend is suitable for a variety of cleaning applications.

### FORMULA NO. 5211

A very mild solvent blend of fluorocarbons and alcohol, designed to remove residues with virtually no attack on plastics, inks and critical assemblies. Developed as a safe, non-flammable replacement for dangerous solvents such as alcohols and naphtha.

### BIO-KLEEN® FORMULA NO. 5779

A concentrated solution which is mixed to make a 3-10% solution with water for removal of rosin flux residue. The mixed solution is used hot (120-140°F.) to readily convert rosin to biodegradable soap solution for disposal in a sanitary sewer. This development in aqueous chemistry eliminates the necessity to use more expensive and hazardous chlorinated and fluorinated solvents. Formula No. 5778 is a modified version for use in batch dishwashers and dip tanks.

### BIO-KLEEN® FORMULA NO. 5769

Another Bio-Kleen® rosin saponifier product for use in spray cleaning equipment. A significant feature of No. 5769 is the increased ability to solubilize unsaponifiable material that is normally present in rosin and in the additives used in some rosin flux formulations. This assures high board cleanliness without white residues sometimes experienced with other saponifier formulations.

### FORMULA NO. 5760 NEUTRALIZER

Formula No. 5760 neutralizer is very effective in completely solubilizing chloride complex residues which result when soldering with organic or inorganic fluxes. Selective chelating agents remove all traces of harmful chloride residues. When diluted to make a 2-10% solution with water, No. 5760 neutralizer is used as an initial rinse, followed by a water rinse. Fresh neutralizer may be added to the solution to maintain the blue indicator color. Formula No. 5761 is a low foaming modification which is used in spray cleaning applications.





FLUX REMOVER SELECTOR GUIDE				METHOD OF FLUX REMOVAL						
KESTER FLUX REMOVER	ROSIN FLUX	ORGANIC WATER-SOLUBLE FLUX	INORGANIC ACID FLUX	VAPOR		COLD IMMERSION	MANUAL TOUCH-UP	BOTTOM BRUSH CLEANING	DISHWASHER	IN-LINE AQUEOUS SPRAY
				BATCH	IN-LINE					
FLUORINATED SOLVENT										
5110	✓			✓	✓	✓	✓			
5211	✓					✓	✓			
CHLORINATED SOLVENT										
5120	✓			✓						
5121	✓			✓	✓	✓				
5130	✓			✓						
5235	✓					✓	✓	✓		
5240	✓				✓	✓	✓	✓		
AP-20	✓					✓	✓	✓		
ROSIN SAPONIFIER										
5769	✓								✓	✓
5778	✓								✓	
5779	✓									✓
NEUTRALIZER										
5760		✓	✓			✓	✓			
5761		✓	✓						✓	✓

## CHEMICAL GUIDE

This guide shows Kester soldering fluxes and chemicals selected from over 200 formulations available from Kester Solder. By consulting the solderability chart, the production or manufacturing engineer can determine the proper flux to use. This assortment of metal cleaners, flux removers and other chemicals provide solutions for solving nearly all soldering problems.

## COMPARATIVE SOLVENT STRENGTH CHART

FORMULA	SOLVENT STRENGTH	FORMULA
No. 5130	100	No. AP20
	90	No. 5240
No. 5121	80	
No. 5120	70	No. 5235
	60	
	50	
	40	
No. 5110	30	No. 5211

## METAL SOLDERABILITY CHART AND FLUX SELECTOR GUIDE

METALS Surfaces Being SOLDERED	SOLDERABILITY	METAL CLEANER	ROSIN FLUXES			ORGANIC FLUXES Water Soluble	INORGANIC FLUXES Water Soluble	
			Non- Activated	Mildly Activated	Fully Activated			
PLATINUM GOLD COPPER TIN SOLDER PALLADIUM SILVER	Easy to Solder	5521* 5521* 5560* 5560* 5560 5560	135	185 195 197 932 1515	1544 1585  1587	1429 2161 2211 2163 2330 2331	Not Recommended for Electrical Soldering	
NICKEL CADMIUM BRASS LEAD BRONZE RHODIUM BERYLLIUM COPPER	Less Easy to Solder	5530 5521 5521 5560 5560 5560 5530				1588  1589	1429 2161 2211 2163 2330 2331	715
NICKEL-IRON KOVAR	Difficult to Solder	5530 5530				1773		
ZINC MILD STEEL CHROMIUM INCONEL MONEL STAINLESS STEEL	Very Difficult to Solder		NOT APPLICABLE				817	
Recommended Flux Residue Remover			5240,5120,5110,5769			5760 NEUTRALIZER		
*NOTE: Solderability can be preserved by coating with Kester 5612 PROTECTO								

**THE  
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# SPECIAL PURPOSE CHEMICALS

## **COPPER-NU® FORMULA NO. 5520**

For cleaning and activating copper and gold-plated copper surfaces without etching away base metal. Formula No. 5520-NF is a non-foaming modification designed for spray cleaning applications.

## **COPPER-NU® FORMULA NO. 5521**

When a controlled amount of etching is required for plating, this formula is stronger than No. 5520. Formula No. 5521 is more effective for activating highly oxidized surfaces. Formula No. 5521-NF is a non-foaming modification designed for spray cleaning applications.

## **NICKEL-NU® FORMULA NO. 5530**

For removing oxidation and activating nickel, tin-nickel and nickel-iron alloys to facilitate soldering. No. 5530 is also very effective for activating heavily oxidized copper surfaces where production requirements necessitate a short cleaning time (5-10 sec.). Formula No. 5530-NF is a non-foaming modification designed for spray cleaning applications.

## **SOLDER-NU® FORMULA NO. 5560**

For cleaning and activating solder and tin coatings, very tarnished copper and silver-plated surfaces.

## **TINNING OIL FORMULA NO. 5738**

A thermally stable, highly refined petroleum oil based formulation for use with automatic soldering machines which employ an oil blanket or oil injection system. No. 5738 is compatible with rosin fluxes and solvent cleaning operations.

## **FORMULA NO. 5750 WATER SOLUBLE TINNING OIL**

A formulation for the same application as No. 5738 except this oil is water soluble. The special formula will not cause excessive foaming in aqueous cleaning machines.

## **FORMULA NO. 5751 WATER SOLUBLE TINNING OIL**

A highly refined synthetic oil for use as a blanket on top of molten solder to minimize drossing. The effective life is longer than No. 5750 as a dross inhibitor and 3-4 times as long as petroleum oil formulations.

## **FORMULA NO. 5740 FUSING COMPOUND**

A white, wax-like solid that melts at 130°F with a flashpoint over 550°F. Used as a heat transfer medium for fusing solder or tin plating and also as a dross inhibitor on

solder baths. The convenient flake form makes additions simple and mess-free.

## **SOLDER-SAVER® FORMULA NO. 5746**

A small amount of this thick liquid is added to and mixed with the accumulated dross on a solder bath. Within seconds 60-90% of the dross is converted to good solder. The small amount of dustless thickened residue is then removed and scrapped.

## **SOLDER-SAVER® FORMULA NO. 5747**

A crystalline powder mixture which melts in wave solder pots to reduce solder dross and minimize further dross formation. No. 5747 is mildly acidic, halide-free, non-smoking, non-combustible and will not carbonize. No. 5747 and its residue are soluble in hot water for greater convenience.

## **PEEL-KOTE™ FORMULA NO. 5780**

A liquid, masking elastomer which is applied to surfaces to act as a temporary resistant coating. When dried, the coating will withstand soldering temperatures to 500°F after which PEEL-KOTE mask can be removed by peeling from the surface, leaving no residue.

## **SOLDER-OFF® DESOLDERING BRAID**

This copper braided wire has been specially treated with a rosin coating to provide maximum wicking ability. The SOLDER-OFF BRAID is placed on the solder to be removed. A hot soldering iron tip is applied to the braid and solder is drawn up into the SOLDER-OFF braid. The solder-free surface that results is then ready for resoldering.

## **PROTECTO™ FORMULA NO. 5612**

For protecting cleaned metal surfaces from contamination during handling or storage. The thin, non-tacky rosin-based coating enhances solderability and dissolves in Kester rosin fluxes during soldering. Thin with No. 5616 Thinner.

## **PROTECTO™ FORMULA NO. 5650**

A rosin-based coating for protecting cleaned metal surfaces from contamination during handling and storage. No. 5650 is designed for roller coating applications. Thin with No. 5655 Thinner.

## **SCALE-OFF™ FORMULA NO. 5565**

A concentrated solution which is diluted 5-10% with water for use in removing mineral deposits (scale) from aqueous cleaning machines. Periodic use maintains efficient operation of aqueous cleaning systems.



**KESTER®**  
SOLDER



## SOLDER ANALYSIS PROGRAM RELIABILITY CONTROL

A regular analysis of solder for contamination can increase solder joint reliability and reduce touch-up of soldered assemblies. Problems such as grittiness, icicling, pin-holing, webbing, dull connections and excess solder, which are caused by impurities in the wave solder bath, can be eliminated by maintaining control of solder composition.

### HOW TO USE THIS SERVICE

To determine the frequency of analysis, establish a regular program of sampling the solder bath each month for 3-6 months. The usable life of the solder and the number of analyses required to control the solder purity can then be determined. Kester Solder originated the sample-mailer system to reduce cost, improve efficiency and assure rapid response.

A quantity of sample-mailer envelopes, including the necessary documentation and instructions can be ordered for annual requirements. When a sample is taken, the sample-mailer is simply sent to the Kester Analytical Laboratories for prompt direct response.

### ANALYSIS OPTIONS

The Kester Solder Analysis Program is designed to effectively provide the control required for various soldering operations. By selecting the analysis option which best monitors the solder composition, the quality of the solder can be maintained.

**Option A** — Many soldering applications require only this basic analysis which includes tin, antimony, copper and gold.

**Option C** — For very critical soldering applications there may be a requirement to monitor other impurities in the solder. This option choice includes cadmium, zinc, aluminum, iron, arsenic, bismuth, silver and nickel in addition to those in Option A.

**Option D** — Some revisions of military specifications require the analysis to include some sulfur and phosphorous. This option choice includes these impurities in addition to those in Option C.

### ANALYSIS REPORT

Each analysis is reviewed by the Analytical Laboratory to determine the quality of the solder. Within 48 hours after receipt of the solder sample the analytical report is mailed. Recommendations are made on the basis of contamination levels shown in the analysis so that the customer can determine whether to continue using or to change the solder.

## CHEMICAL TEST KITS

Chemical test kits have been developed to serve three areas of electronics soldering applications:

PRODUCTS FOR GENERAL & CONSUMER ELECTRONICS

PRODUCTS FOR COMPUTER, TELECOMMUNICATION & OTHER CRITICAL ELECTRONICS

PRODUCTS FOR SEMICONDUCTOR LEAD TINNING

Each kit provides a miniature chemical testing laboratory to perform initial soldering evaluations. Selected fluxes, cleaners and other products are contained in each test kit from over 200 available formulations. By consulting the application chart in each test kit, the process or production engineer can scientifically approach many soldering problems.

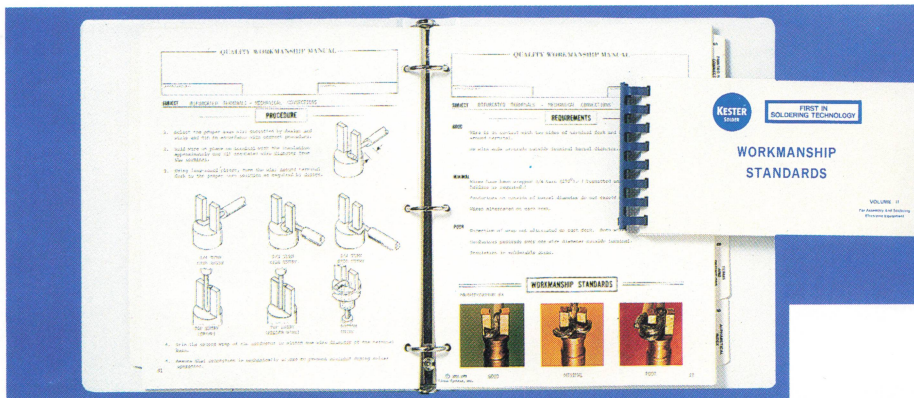


### HYDROMETER/FLUX TEST KIT

Checking the specific gravity or density of rosin fluxes used for wave soldering is a requirement for controlling the process. This kit includes a syringe, bulb and hydrometer calibrated 0.830 to 0.930, a range suited for Kester rosin fluxes. By simply drawing flux into the syringe, the hydrometer can be read and the correct amount of thinner added to the flux to correct density.

### QUALITY WORKMANSHIP MANUALS

This two volume set is a compilation of proven industrial procedures and standards to make reliable solder connections. These manuals are ideal for training purposes as well as providing quality criteria for line workers. Information is presented in concise language supported by diagrams and illustrations. Over 120 full-color photographs of acceptable, minimal and rejectable assembly techniques and soldered connections are provided. Explanations accompany each condition so that the quality control inspector can make the proper determination.





# Litton

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